Revista Facultad Nacional de Agronomía Medellín
ISSN: 0304-2847
ISSN: 2248-7026
Facultad de Ciencias Agrarias - Universidad Nacional de Colombia

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Revista Facultad Nacional de Agronomía Medellín,
vol. 74, no. 1, 2021, January-April, pp. 9403-9411
Facultad de Ciencias Agrarias - Universidad Nacional de Colombia

DOI: https://doi.org/10.15446/rfnam.v74n1.89032

Research article

http://www.revistas.unal.edu.co/index.php/refame

Revista Facultad Nacional de Agronomía

UNIVERSIDAD NACIONAL DE COLOMBIA

Digitaria insularis control by using herbicide mixtures application in soybean pre-emergence

Control de *Digitaria insularis* por medio de la aplicación de mezclas de herbicidas en la pre-emergercia de la soya

doi: 10.15446/rfnam.v74n1.89032

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ABSTRACT

Sourgrass (*Digitaria insularis*) is one of the main weeds in the soybean crop. In order to control its growth, an increase of herbicide rates is required to simplify its management as it a plant with high vegetative capacity and seed production. It implies to select the herbicide-resistent Digitaria insularis biotypes. Nevertheless, some information is still contrasting the antagonist of synthetic auxinic herbicides, associated with glyphosate and ACCase inhibitors mixtures, for the control of weeds resistant or tolerant to herbicides. This study aimed to evaluate the *D. insularis* control, with a mixture of herbicides applied in soybean pre-emergence, with sequential application in soybean post-emergence, and to check possible antagonism between ACCase inhibitors herbicides with synthetic auxins and other latifolicides. The experiment was conducted in Palotina, Paraná (Brazil) and Corpus Christi, Canindeyú, (Paraguay.) The treatments consisted of associations of glyphosate, ACCase inhibitors (clethodim, haloxyfop), and latifolicides (2,4-D, triclopyr, dicamba, carfentrazone, saflufenacil, chlorimuron). A randomized block design was used. Only in Palotina, the weed control was satisfactory after sequential application in post-emergence. An antagonism for all synthetic auxins was observed with glyphosate+clethodim or haloxyfop mixtures, in both locations. As a result, in Palotina an efficacious control of perennial *D. insularis* was found in pre-emergence burndown for some mixtures such as glyphosate+ACCase inhibitor added to carfentrazone, saflufenacil, or chlorimuron. Antagonism was observed for all synthetic auxins, in both locations. In Corpus Christi, the herbicide associations were not effective, even with the post-emergence application in soybean of glyphosate+clethodim. With ineffective control for treatments composed with synthetic auxins, the post-emergence application in soybean increased the weed control with satisfactory final controls for all treatments.

Keywords:
Antagonism
Herbicides resistance
Sourgrass
Synthetic auxinic
Weeds

RESUMEN

El pasto amargo (*Digitaria insularis*) es una de las principales malezas en el cultivo de soya. Para controlar su crecimiento, se requiere un aumento de las tasas de herbicida para simplificar su manejo al ser una planta con alta capacidad vegetativa y producción de semillas. Esto implica seleccionar los biotipos de Digitaria insularis resistentes a herbicidas Sin embargo, aún existe cierta información contrastante que considera el antagonismo de los herbicidas auxínicos sintéticos en las mezclas con inhibidores de ACCase y glifosato, para el control de malezas resistentes o tolerantes a los herbicidas. El estudio tuvo como objetivo evaluar el control de *D. insularis* con mezclas de herbicidas aplicados en la pre-emergencia y pos-emergencia del cultivo de soya y se verificó el posible antagonismo entre los herbicidas inhibidores de ACCase con auxinas sintéticas y otros latifolicidas. El experimento se realizó en Palotina, Paraná, (Brasil) y Corpus Christi, Canindeyú (Paraguay). Los tratamientos consistieron en mezclas de glifosato, inhibidores de ACCase (cletodim, haloxifop) y latifolicidas (2,4-D, triclopir, dicamba, carfentrazona, saflufenacil, clorimurón). Se utilizó un diseño de bloques al azar. El control de arvenses fue satisfactorio sólo en Palotina después de la aplicación secuencial en pos-emergencia. Allí se observó un control efectivo de *D. insularis* en la pre-emergencia, para algunas mezclas que presentaron glifosato+ACCase+carfentrazona, saflufenacil o clorimurón. Se observó antagonismo para todas las auxinas sintéticas en ambas ubicaciones. En Corpus Christi las mezclas de herbicidas no fueron efectivas, incluso con la aplicación de glifosato+cletodim en la pos-emergencia de soya. Aunque se obtuvo un control ineficaz para tratamientos compuestos con auxinas sintéticas, la aplicación en post-emergencia de soya aumentó el nivel de control, con resultados finales satisfactorios para todos los tratamientos.

Palabras clave:
Antagonismo
Resistencia a los herbicidas
Pasto amargo
Auxinas sintéticas
Malezas

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Received: September 9, 2020; Accepted: November 11, 2020
Rev. Fac. Nac. Agron. Medellín 74(1): 9403-9411. 2021
ISSN 0304-2847 / e-ISSN 2248-7026

Sourgrass (*Digitaria insularis* [L.] Fedde), a Poaceae perennial weed, is infesting large areas across South America. Its dissemination is occurring because of the plant characteristic, such as tufted formation, rhizome structures, high seed production, and because of the pressure selection of plant biotypes with resistance to glyphosate and ACCase herbicides (Machado *et al*., 2008; Veldman and Putz, 2011; Melo *et al*., 2012; Gemelli *et al*., 2013; Gazola *et al*., 2019). All these characteristics avoid the easy control of this plant, genarating interference in crops. For instance, the coexistence of six plants m^{-2} of *D. insularis* with soybean crop is enough to reduce its yield in 40% (Gazziero *et al*., 2019).

The glyphosate has been used as the main herbicide in weeds management for many years, but its intensified use in weed pre-sowing control with non-tillage system and post-emergence generates glyphosate-tolerant transgenic crops (Green, 2018). *D. insularis* has a great vegetative propagation and a high seed production in a short time with seed germination across the year. Therefore, it is required to increase the rates of herbicides for effective control.

This grass presents cases of resistance to herbicides in Brazil, with resistance to glyphosate (Adegas *et al*., 2010; Carvalho *et al*., 2011) and ACCase inhibitors (haloxyfop and pinoxaden) (Takano *et al*., 2020).

There are many ways to manage the *D. insularis* resistant to glyphosate, including the herbicide application in the early stage of development, avoiding seed production, rotation of herbicides with different mechanisms of action or chemical groups, among other cultural practices including the burndown. It could be important for the effective management of *D. insularis*; its use must be implemented in advance of sowing and as complementary application to other products (Oliveira-Júnior *et al*., 2006; Canedo *et al*., 2019). The burndown immediately before sowing involves the application of one or more herbicides (usually systemic action), its choosing depends on the floristic composition of the site and infestation density (Oliveira-Júnior *et al*., 2006; Frisvold *et al*., 2020).

Particularly for *D. insularis*, there are few herbicides for chemical control. Paraquat, for example, with a single application is not enough to eradicate the whole plant causing re-growth (Zobiole *et al*., 2016). Besides, paraquat is being taken off the market in Brazil in September 2020 (ANVISA, 2020). Diquat is neither a great alternative in the control of grasses, generally with low efficacy improving when is associated with adjuvants; however still being unsatisfactory option to control it (Gitsopoulos *et al*., 2014). On the other hand, the use of ACCase herbicides, especially "fop" herbicides could lead to a rapid herbicide-resistant biotypes selection (Takano *et al*., 2020).

The use of herbicides of different mechanisms of action and with the same control spectrum is one strategy that must be used. Because of the presence of other weeds in the field, with infestation of grasses and broad-leaved, it is common the spray of glyphosate or ACCase mixed with synthetic herbicides. There are reports of the antagonist effect of 2,4-D on the action of ACCase inhibitors graminicides (Gomes *et al.,* 2020), due to the reduction of translocation and increase of herbicides metabolism from the ariloxifenoxipropionics group (Trezzi *et al*., 2007). Pereira *et al*. (2018) observed that synthetic auxinic (2,4-D and dicamba) associated with haloxyfop interfered negatively on *D. insularis* control.

There is still contrasting information that considers the antagonist action of 2,4-D and other synthetic auxinic herbicides (triclopyr and dicamba) mixtures with glyphosate and ACCase inhibitors. As *D. insularis* has few options of herbicides for chemical control, this study aimed to evaluate the control of *D. insularis*, with glyphosate plus ACCase inhibitors and latifolicides applied in pre-emergence and verify possible antagonism between ACCase inhibitors herbicides with synthetic auxins and other latifolicides.

MATERIALS AND METHODS

Design and experimental conditions

Two experiments were installed in a commercial area in 2018-2019 season. Palotina, Paraná (PR), Brazil, (24°2326.93"S 53°84'51.36"W) and Corpus Christi, Canindeyú, Paraguay (24°3'37.24"S 55°0'22.22"W) were the locations selected. The climate of both regions is classified as Cfa (humid subtropical with abundant rainfall, well distributed throughout the year), according to Köppen classification. Figure 1 (A,B) presents climate data during the period of experiment conduction.

Both areas had a high population of perennial sourgrass at flowering stage, with records of use of glyphosate, and

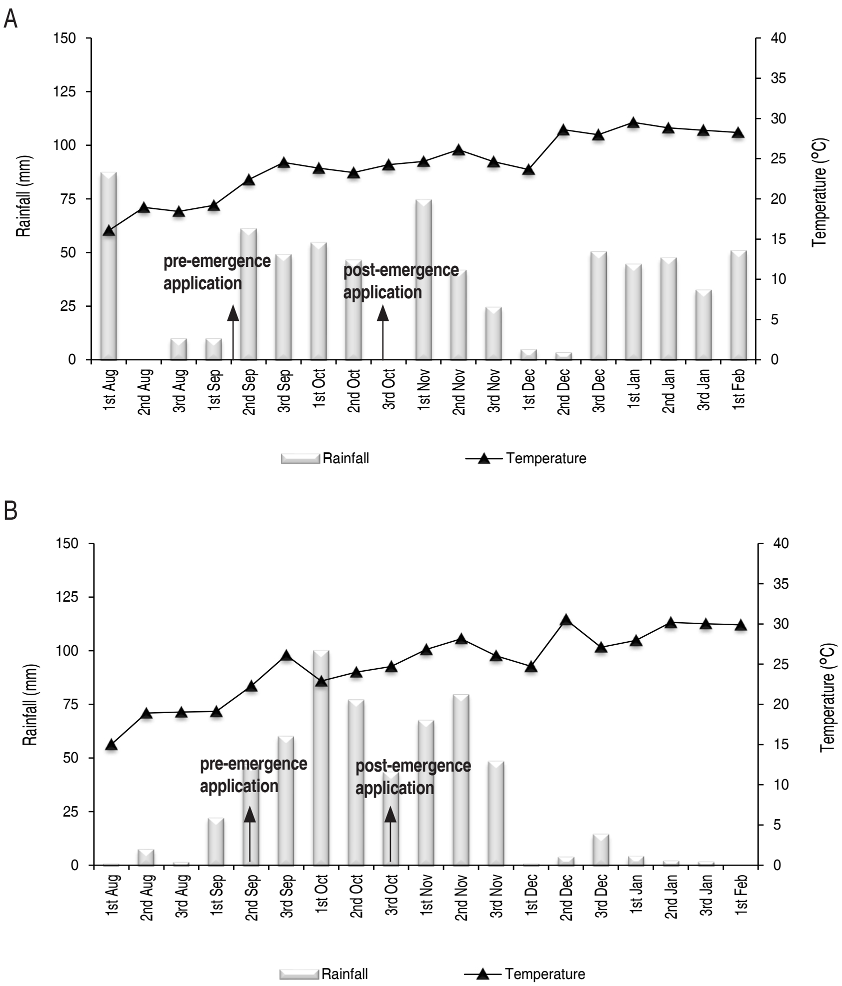

Figure 1. Rainfall representation average temperature for the experiment site. Aug – Nov 2018. A. Palotina, PR, Brazil. B. Corpus Christi, Canindeyú, Paraguay.

its loss of efficacy in recent years. Palotina assay had a populational density average of 1 to 2 tufts m^{-2}, meanwhile, in the Paraguay area, the populational density was higher, 2 to 4 tufts m^{-2}. The experiments were installed in a fallow field, prior to soybean sowing. Previously, the Palotina area had been cultivated with maize crop, and Corpus Christi was a fallow area since the soybean harvest in summer (without second season crop). A randomized block with four replications was used in the experimental design. The experimental plots were composed of 3x5 m^{-2}. The treatments are described in Table 1. The treatment applications were performed two days before soybean sowing. In Palotina the application occurred on September 11, 2018, at 29 °C, relative humidity of 60%, and wind speed of 6.5 km h^{-1}. While in Corpus Christi on September 15, 2018, the temperature was 23.9 °C, relative humidity 72.3%, and wind speed 6.8 km h^{-1}. The application of M1 in soybean post-emergence was performed 42 days after emergence (DAE) in both locations, with soybean plants at the V4-V5 stage (BBCH, 2001). This application was carried out in all treatments, except in the weedy control (without any application). In Palotina the application occurred on Octuber 30, 2018, at temperature of 30 °C, relative humidity of 58%, and wind speed of 5.1 km h^{-1}. In Corpus Christi on November 03, 2018, the temperature was 26.9 °C, relative humidity 78%, and wind speed 6 km h^{-1}.

Table 1. Mixtures of herbicides application to control the *D. insularis*. 2018-2019 season.

Mixtures (M)	Herbicides[a]	Rates[b] (g)
	weedy control (without application)	–
1	glyphosate + clethodim[1]	1,080 + 192
2	glyphosate + haloxyfop[2]	1,080 + 120
3	glyphosate + clethodim[1] + 2,4-D	1,080 + 192 + 1,005
4	glyphosate + haloxyfop[2] + 2,4-D	1,080 + 120 + 1,005
5	glyphosate + clethodim[1] + triclopyr	1,080 + 192 + 960
6	glyphosate + haloxyfop[2] + triclopyr	1,080 + 120 + 960
7	glyphosate + clethodim[1] + dicamba	1,080 + 192 + 480
8	glyphosate + haloxyfop[2] + dicamba	1,080 + 120 + 480
9	glyphosate + clethodim[1] + carfentrazone	1,080 + 192 + 30
10	glyphosate + haloxyfop[2] + carfentrazone	1,080 + 120 + 30
11	glyphosate + clethodim[1] + saflufenacil	1,080 + 192 + 49
12	glyphosate + haloxyfop[2] + saflufenacil	1,080 + 120 + 49
13	glyphosate + clethodim[1] + chlorimuron	1,080 + 192 + 20
14	glyphosate + haloxyfop[2] + chlorimuron	1,080 + 120 + 20

Comercial product (common name) - Manufacturer

Roundup® Original (glyphosate) - Monsanto do Brasil Ltda, São Paulo, SP, Brazil. Select® 240 EC (clethodim) - Arysta Lifescience do Brasil S.A., São Paulo, SP, Brazil. Verdict® R (haloxyfop) - Dow Agrosciences Ltda, São Paulo, SP, Brazil. DMA® 806 BR (2,4-D) - Dow Agrosciences Ltda, São Paulo, SP, Brazil. Triclon® (triclopyr) - Volcano Agrociencia Ltda, São Paulo, SP, Brazil. Atectra® (dicamba) - Basf S.A., São Paulo, SP, Brazil. Aurora® 400 EC (carfentrazone) - FMC Química do Brasil Ltda, Campinas, SP, Brazil. Heat® (saflufenacil) - Basf S.A., São Paulo, SP, Brazil. Classic® (chlorimuron) - Du Pont do Brasil S.A., Barueri, São Paulo, SP, Brazil.

[1]Adjuvant use: Lanzar® 0.5% v/v (Arysta Lifescience do Brasil S.A., São Paulo, SP, Brazil); [2]Adjuvant use: Joint® Oil 0.5% v/v (Dow Agrosciences Ltda, São Paulo, SP, Brazil).

[a] Followed by application of glyphosate (1,000 g acid equivalent [a.e] ha^{-1}) + clethodim (108 g active ingredient [a.i] ha^{-1}), in soybean post-emergence (V4-V5), except for weedy control (without application).

[b] Rates in g a.e. ha^{-1} for glyphosate, haloxyfop, 2,4-D, and triclopyr; for the others, rates in g a.i. ha^{-1}.

CO_2-pressurized sprayer was used for all herbicide applications. It was equipped with six AIXR 110 015 spray nozzles spaced 0.5 m from each other, 2.5 kgf cm^{-2} calibrated pressure and speed of 1 m s^{-1}, resulting in a spray volume of 150 L ha^{-1}.

Evaluations and statistical analysis

At soybean pre-emergence, the visual evaluations of control were done at 7, 14, 21, 28, and 35 days after application (DAA) for both experiments. The control also was evaluated at 7, 14, and 21 DAA, in Palotina, and at 7 and 14 DAA in Corpus Christi, at soybean post-emergence. Percentage values from 0 up to 100% were assigned for the evaluation (0 no injuries, 100% plant death) with regard to weedy control (Velini *et al.*, 1995).

The data were submitted to analysis of variance (ANOVA) by F-test (P<0.05), according to Pimentel-Gomes and Garcia (2002). The means of treatments were grouped by Scott and Knott (1974) test (P<0.05). Sisvar 5.6 software was used for the analysis (Ferreira, 2011).

RESULTS AND DISCUSSION

All treatments with clethodim were more effective compared with haloxyfop treatments from 21 to 35 DAA (Palotina). At 7 DAA, there were not high levels of control, at most 39.8% (Table 2). On the other hand, the treatments with saflufenacil provided greater control, even 39.75% higher than other treatments. For 35 DAA, stands out that the best results were observed for treatments M13 or M9, with values up to 94.1%. After the post-emergence application of M1, it was observed some differences between the treatments, there were lower values for some treatments with haloxyfop application, but all mixtures provided minimum control of 89.5%, at 21 DAA (Table 2).

Table 2. Control treatments to *D. insularis* at 7, 14, 21, 28, and 35 days after the application (DAA) of herbicides, at soybean pre-emergence, and at 7, 14, and 21 DAA at soybean post-emergence. 2018-2019 season, Palotina, PR, Brazil.

Mixtures (M)	Treatments	Pre-emergence application (DAA)					Post-emergence application (DAA)		
		7	14	21	28	35	7	14	21
		(%)							
	weedy control (without application)	0.0 d	0.0 e	0.0 g	0.0 f	0.0 h	0.0 e	0.0 d	0.0 c
1	gly + clethodim	18.8 c	81.5 a	91.9 a	94.9 a	83.0 b	80.8 b	86.5 a	95.8 a
2	gly + haloxyfop	16.9 c	65.8 b	65.8 d	68.9 c	39.8 f	51.0 d	85.5 a	90.9 b
3	gly + clethodim + 2,4-D	27.4 b	76.4 a	72.3 c	64.0 d	55.4 e	63.0 c	79.5 b	94.3 a
4	gly + haloxyfop + 2,4-D	19.4 c	43.0 d	45.1 f	42.3 e	28.9 g	47.0 d	85.5 a	92.8 a
5	gly + clethodim + triclopyr	22.5 c	82.1 a	82.9 b	79.6 b	68.0 d	75.0 b	92.8 a	95.3 a
6	gly + haloxyfop + triclopyr	19.4 c	52.3 c	53.5 e	45.8 e	34.6 g	49.5 d	74.8 b	90.0 b
7	gly + clethodim + dicamba	24.0 b	76.1 a	84.3 b	84.1 b	78.6 c	81.0 b	88.8 a	98.0 a
8	gly + haloxyfop + dicamba	13.9 c	54.0 c	45.8 f	44.3 e	34.6 g	43.8 d	68.5 c	89.5 b
9	gly + clethodim + carf	19.5 c	81.3 a	93.5 a	95.4 a	94.1 a	90.5 a	91.5 a	94.5 a
10	gly + haloxyfop + carf	19.9 c	55.4 c	60.8 d	66.3 c	53.1 e	57.0 c	74.3 b	92.8 a
11	gly + clethodim + saflufenacil	39.8 a	86.5 a	90.4 a	91.5 a	83.8 b	81.5 b	91.3 a	93.3 a
12	gly + haloxyfop + saflufenacil	33.8 a	77.3 a	58.3 e	59.8 d	40.1 f	45.0 d	71.0 c	89.5 b
13	gly + clethodim + chlorimuron	26.3 b	79.9 a	90.9 a	95.5 a	89.5 a	90.0 a	93.3 a	97.3 a
14	gly + haloxyfop + chlorimuron	16.4 c	43.6 d	57.4 e	71.0 c	51.4 e	60.3 c	90.0 a	93.5 a
	Mean	21.2	63.7	66.2	66.9	55.5	61	78.2	87.1
	CV (%)	10.1	9.4	6.6	6.9	9.8	6.8	6.2	3.6
	F	*	*	*	*	*	*	*	*

gly: glyphosate, carf: carfentrazone.
* Means followed by the same letters in the column do not differ by Scott and Knott (1974) test (P<0.05).

In Corpus Christi, the control was lower in general, probably due to the higher infestation of perennial plants. The higher averages on 28 DAA were reached by the treatment's M2, M12, M13, and M14 up 74.5%. Even after the post-emergence application at 14 DAA using M11, a *D. insularis* control up 66% was observed (Table 3).

M11 was effective in the control, especially in the first evaluations in Palotina. The application of glyphosate+saflufenacil has been reported effective especially to control eudicotyledon weeds, for example, *Conyza* spp. (Mahoney *et al.*, 2016). However, saflufenacil does not present high control on *Digitaria* spp. (Soltani *et al.*, 2014). Nevertheless, in this study, in Palotina, it could be an adjuvant on *D. insularis* control, when was mixed with clethodim (M11) or haloxyfop (M12). The addition of saflufenacil in the mixtures did not increase the control promoted by glyphosate+clethodim; however it did not have an antagonistic effect. Mixtures like this have a broad spectrum of action, being important in weed management in infested areas with *D. insularis* and other weeds (Roskamp *et al.*, 2012).

In Palotina, all treatments with clethodim were more effective compared with haloxyfop treatments from

Table 3. Control treatments to *D. insularis* at 7, 14, 21, 28, and 35 days after the application (DAA) of herbicides, at soybean pre-emergence, and at 7, 14, and 21 DAA at soybean post-emergence. 2018-2019 season, Corpus Christi, Canindeyú, Paraguay.

Mixtures (M)	Treatments	Pre-emergence application (DAA)					Post-emergence application (DAA)	
		7	14	21	28	35	7	14
		%						
	weedy control (without application)	0.0 d	0.0 f	0.0 e	0.0 e	0.0 d	0.0 c	0.0 c
1	gly + clethodim	10.3 c	19.3 d	62.0 c	64.5 b	46.8 b	52.0 b	55.0 b
2	gly + haloxyfop	8.8 c	18.8 d	58.0 d	69.8 a	55.0 a	55.5 a	65.0 a
3	gly + clethodim + 2,4-D	9.5 c	17.5 e	54.3 d	43.0 d	34.8 c	49.3 b	53.5 b
4	gly + haloxyfop + 2,4-D	8.8 c	15.0 e	55.3 d	51.5 c	41.8 b	48.0 b	51.5 b
5	gly + clethodim + triclopyr	10.0 c	25.5 c	63.5 c	52.5 c	48.0 b	51.3 b	54.5 b
6	gly + haloxyfop + triclopyr	10.5 c	22.0 d	61.8 c	51.3 c	47.0 b	52.0 b	61.0 a
7	gly + clethodim + dicamba	9.5 c	20.8 d	55.3 d	54.0 c	47.5 b	52.8 b	56.3 b
8	gly + haloxyfop + dicamba	10.3 c	21.3 d	59.0 d	52.0 c	46.8 b	48.8 b	60.3 a
9	gly + clethodim + carf	11.0 c	25.3 c	66.3 c	45.5 d	43.0 b	49.3 b	55.5 b
10	gly + haloxyfop + carf	11.0 c	27.3 c	71.8 b	59.8 b	45.0 b	53.5 b	56.3 b
11	gly + clethodim + saflufenacil	13.0 b	33.0 b	75.0 b	60.3 b	57.0 a	60.5 a	66.0 a
12	gly + haloxyfop + saflufenacil	17.5 a	44.0 a	80.8 a	73.0 a	58.8 a	61.0 a	63.3 a
13	gly + clethodim + chlorimuron	17.0 a	31.3 b	66.5 c	69.8 a	55.0 a	56.3 a	58.0 b
14	gly + haloxyfop + chlorimuron	15.5 a	29.8 b	63.0 c	74.5 a	57.8 a	61.5 a	61.3 a
	Mean	10.8	23.4	59.5	54.8	45.6	50.1	54.5
	CV (%)	16.5	12.7	7.5	10	8.5	10.8	8.2
	F	*	*	*	*	*	*	*

gly: glyphosate, carf: carfentrazone.
* Means followed by the same letters in the column do not differ by Scott and Knott (1974) test ($P<0.05$).

21 to 35 DAA. Zobiole *et al*. (2016) did not observe differences on *D. insularis* control between clethodim and haloxyfop mixed with glyphosate. Cassol *et al*. (2019) found similar efficacy of clethodim and haloxyfop in association with glyphosate on perennial *D. insularis* control and at soybean post-emergence weed control, but in the control of plants in the off-season, clethodim+glyphosate was more powerful than haloxyfop+glyphosate.

Other studies highlight the efficacy of clethodim and haloxyfop, at different mixtures, on *D. insularis* control (Barroso *et al*., 2014; Gilo *et al*., 2016). Nonetheless, it is not possible to determine which one is more effective on *D. insularis* control; their choice should consider several factors including the background of the use of these herbicides in the area. According to López-Ovejero *et al*. (2017), Takano *et al*. (2018), and Lucio *et al*. (2019) it is crucial to rotate the chemical groups in order to avoid herbicide-resistant *D. insularis* biotypes.

A reduction in weed control was found in both locations from 14 DAA regarding the synthetic auxins in association with ACCase inhibitors. In Palotina, at 28 DAA, 30.93, 15.30, and 10.85% of control losses were observed when 2,4-D (M3), triclopyr (M5), and dicamba (M7) were mixture with glyphosate+clethodim, respectively. In Corpus Christi at 28 DAA, the losses of effectiveness were 21.5, 17.25, and 10.5% for treatments with 2,4-D (M3), triclopyr (M5), and dicamba (M7) respectively, when compared with glyphosate+clethodim treatment. In relation to glyphosate+haloxyfop associations, the auxins 2,4-D, triclopyr and dicamba provided a reduction of 18.25, 18.5, and 17.75% in control effectiveness. At the same time, the treatments with auxinics added to haloxyfop provided 42.25% (M3), 45.25% (M6), and 45.75% (M8) of weed control.

In this study, antagonism and reductions were verified by the association of ACCase inhibitors, as haloxyfop with 2,4-D (M4) and dicamba (M8). By Pereira *et al*. (2018), some cases more than 40% was observed for both. Clethodim+dicamba is also reported as an antagonist, with losses of 6 to 15%, in volunteer maize control in soybean (Underwood *et al*., 2016). The losses due to antagonism were of 11.85% in Palotina and 10.5% in Corpus Christi treated with M7.

In the case of haloxyfop, the antagonism on these mixtures is possibly explained by the reduction of translocation. (Olson and Nalewaja, 1981). The clethodim+2,4-D antagonism was detected due to leaf necrosis in a few days after application (Gomes et al., 2020). This can result in less absorption and translocation triggering the less weed control. Mixtures of triclopyr with ACCase inhibitors also reduce its effectiveness on grasses control (Scherder *et al*., 2005). About dicamba, it can be also explained for the possible reduction of translocation of the graminicide to the roots and the plant's rhizome (Aguero-Alvarado *et al*., 1991).

The *D. insularis* control varied between the two locations, which could be explained by higher population density in Corpus Christi. While the lower efficacy of haloxyfop treatments (compared to clethodim) in Palotina, probably it is a risk warning for the selection of haloxyfop resistant biotypes. There are records of the *D. insularis* resistence to this herbicide and pinoxaden in Brazil (Takano *et al*., 2020).

In a general context, the *D. insularis* control was satisfactory for treatments with triple combinations, only in the Palotina area. There, even with ineffective control for treatments composed with synthetic auxins, the post-emergence application in soybean increased the control level, with satisfactory final controls for all treatments. However, antagonism was observed for all synthetic auxins in both locations.

The coexistence of six plants m^{-2} of *D. insularis* with soybean crop is enough to reduce yield in 40% (Gazziero *et al*., 2019). In Corpus Christi with a population of 2 to 4 tufts per m^2, the application was not effective. The anticipated control of *D. insularis* populations should be a priority to avoid crop losses due to weeds competition. The combination of ACCase inhibitors (haloxyfop, clethodim) and synthetic auxins (2,4-D, dicamba, and triclopyr) is not recommended. Another option is to use the auxin herbicides in sequential application. For instance, by Leal *et al.* (2020) haloxyfop must be applied at least 6 days before 2,4-D to control *Conyza* spp. and *D. insularis* when they are present simultaneously.

CONCLUSION

In Palotina, the perennial *D. insularis* control at soybean pre-emergence burndown was effective in some mixtures that presented glyphosate+ACCase inhibitor added to carfentrazone, saflufenacil, or chlorimuron, demonstrating the potential use of these associations for weed control. Even with ineffective control for treatments composed with synthetic auxins, the post-emergence application in soybean increased the control level, with satisfactory final controls for all treatments

In Corpus Christi, the herbicides combinations were not effective, even after the post-emergence application of glyphosate+clethodim.

Clethodim and haloxyfop had a reduction on the efficiency in combination with the synthetic auxins 2,4-D, triclopyr, and dicamba. Among synthetic auxins, dicamba showed the lowest antagonism.

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